interest to mention that when handled, the reptiles showed a considerable dislike of being touched either before or behind the junction of the back legs with the body. Their response to such handling was quickly to move the legs either forward or backward in such a way as to cover this apparently vulnerable area, and in doing so the body spines and the leg spines acted more or less as pioneers. If this process were repeated a number of times both fore and aft of the legs, most individuals would abandon the "freeze" and endeavour to make off.

Further observations by Ella McFadyen, referred to in the same paper, suggest that the *Moloch* sleeps with the head raised, but all captive individuals observed by torchlight at night at Coorow were in the collapsed stance.

Le Souef, from observations made on captive specimens liberated at Taronga Park, notes six eggs, and E. R. Waite in *The Reptiles and Amphibians of South Australia,* states that as many as eight have been laid in a clutch in captivity. The apparently large number of ten eggs recorded in the Coorow *Molochs* may bear some relationship to the extraordinary bountiful supply of food to be found there. It was not uncommon to find ant trails up to an inch in width.

Mr. L. Glauert of the Western Australian Museum informs me that correspondents have written to him describing the method of egg-laying, adding that the young hatched out in approximately eight weeks.

BIOCLIMATIC CONTROLS IN WESTERN AUSTRALIA

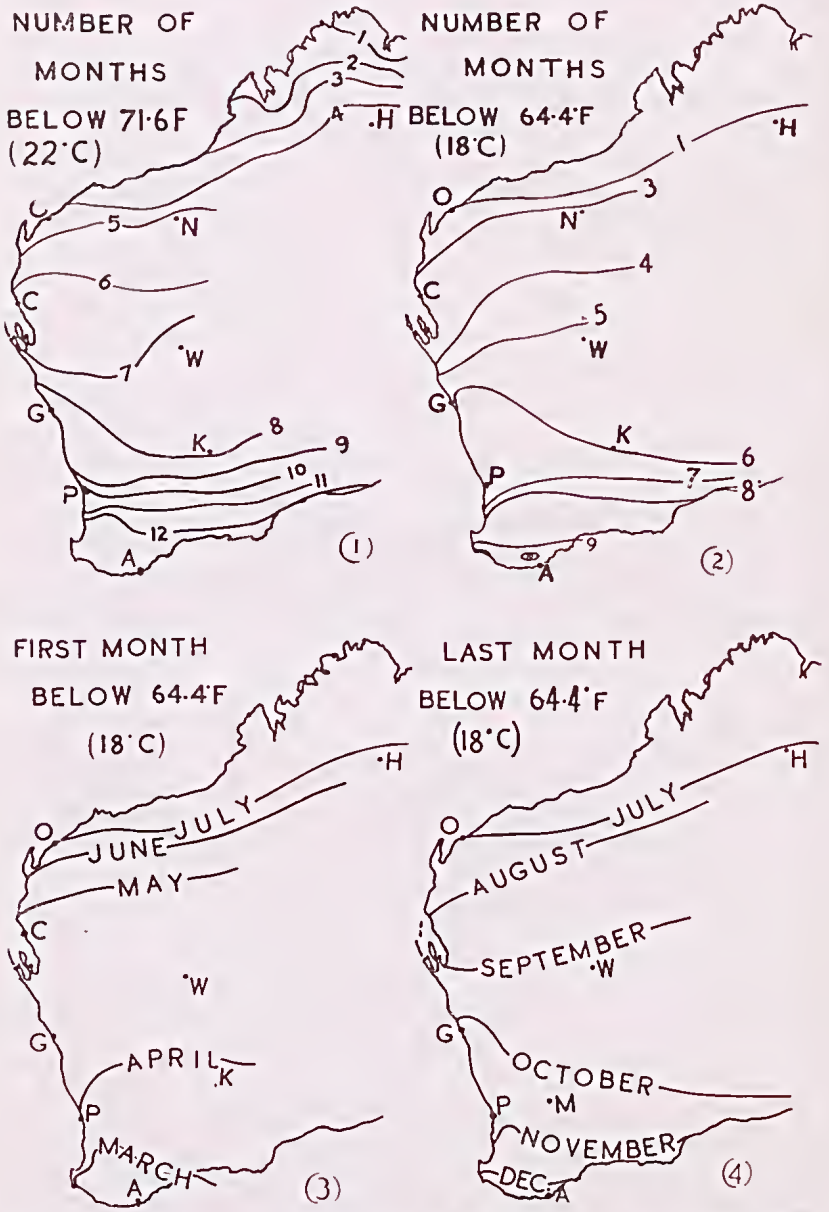
By Dr. J. GENTILLI, University of Western Australia, Nedlands.

It is well known that climate affects plant and animal life to a very great extent, and yet the student of nature finds it hard to make use of many climatic maps which are available, because they are not suited to his needs. Annual averages, for instance, mean but little to living organisms, and yet most of the maps available show annual averages of temperature or rainfall. The year is too long a period to be taken as a whole, without subdivisions; many plants and many animals go through their whole life-cycle within less than a year. In perennial plants, the vegetative cycle takes place within the year; in animals there are cycles which take place within the year, as nesting and mating seasons well show.

If climatic information is to be used for the study of life, it is therefore necessary to work on periods shorter than a year. Much work has already been done in North America and northern Europe, with regard to the effect of temperature on plant growth; in many countries research has been made into the effect of seasonal rains on wheat, maize and other crops. These studies show that every species has its own requirements, so that it would be impossible to map out climatic information suitable for every branch of natural science. All that may be attempted is the compilation of type-maps, which may serve as a guide and lead the

student of nature to compile his own special maps as required, or make him appeal to the nearest climatologist or geographer for assistanee.

In countries nearer to the polar eireles great stress is laid upon the length of day, but this factor is almost negligible in Australia, so that the present paper will deal with temperature and moisture, with a brief outline of the geographieal factors in the background.



(H., Hall's Creek; N., Nullagine; O., Onslow; C., Carnarvon; W., Wiluna; G., Geraldton; K., Kalgoorlie; P., Perth; M., Merredin; A., Albany.)

TEMPERATURE*

Northern hemisphere workers have stressed the importance of low temperatures as limiting factors in plant growth. Temperatures of 32° F. for one month, or 43° F. for three months, have been mentioned as the limit of deciduous forests. Lower temperatures set a limit to coniferous forests. Western Australia knows some occasional frost in the south-western districts, but low temperatures are never experienced for any length of time. It may be said that low temperatures never act as limits in this area.

High temperatures may set the equatorial limit to life of temperate regions; they may be of great importance as limiting factors in the southern part of Western Australia.

Very high temperatures experienced occasionally may hardly be important, although they may result in the death or migration of many individuals at the time. Less high temperatures experienced over a long enough period may be of great biological importance, and a temperature of 22° C. (71.6° F.) may be quoted as an example (Map 1). Plants that require a hot summer hardly venture into the region where all the 12 months are below 22° C. (71.6° F.). The tropical realm may well begin where there are at least four months above this temperature and eight months below, roughly north of a line drawn from Northampton to Kalgoorlie. At the tropic itself the year is evenly divided, half above and half below this temperature.

Another important temperature is 18° C. (64.4°F.). Some climatologists take this as the cold limit of hot-region plants, so that if even one month a year is cooler than 18° C. (64.4° F.), the vegetation is no longer as luxuriant as it is under hotter conditions—other things being equal. Physiologists associate this temperature with the optimum production of spermatozoa in human beings, so that it may be taken as a climatic limit in this respect; fertility tends to decrease under hotter conditions.

Map 2 shows that a line from Geraldton to Kalgoorlie corresponds to an even division of the year into six months hotter and six months colder than 18° C. (64.4° F.). This agrees with the limit of the tropical realm as obtained from Map 1. A line from Onslow to Hall's Creek gives the southern boundary of the constantly hot region.

It must be stressed that species and even individuals have their own temperature optimums and limits, so that these maps can only be used as a guide to assess the periods of cool or hot conditions during the year. In the case of cold-blooded animals temperature is a factor which may be of vital importance. In the

*The word "temperature" in this paper is used to signify "normal mean temperature," i.e., the arithmetic average of temperatures taken over as long a period as possible. Usually this average is obtained by adding maximum and minimum temperatures and dividing by two, for each day or any number of days, months or years as required. In the maps where the first and the last months below a certain temperature are shown, the word "month" refers to a period of about 30 days with a normal mean temperature below the stated value.

case of plants its importance varies with the species or individuals concerned. If during the course of any research temperature factors are suspected, Maps 1 and 2 should be used in order to assess the significance of the temperature limits given. If none of these is satisfactory, new maps should be constructed for other temperatures which may be more relevant.

It often happens that feeding or mating conditions are so affected by temperature that animals migrate in order to find optimum conditions. Map 3 provides a useful instrument for the study of these migrations, because it shows the normal month of the year when temperate conditions prevail. The temperature of 18° C. (64.4° F.) has been taken as an example, and the advance of this temperature from south to north has been mapped. The map can also be interpreted as showing the time of the year when similar temperature conditions prevail at different places. Thus July temperature conditions at Onslow are equivalent to May temperature conditions at Carnarvon and April conditions at Perth. The retreat of the same temperature southwards is shown in Map 4. In addition, the march of other temperatures may be significant, and similar maps could be compiled.

Temperature maps of the more usual type, showing average temperatures for various months and for the year, and annual and daily temperature ranges, are already available in the author's volume on "Australian Climates and Resources" (1947) and need not be repeated here.

(To be continued).

FROM FIELD AND STUDY

Growth of the Blackboy.—When I was young (10 years of age) one of the games of my mates and myself was to "ride" certain of the blackboys *(Xanthorrhoea preissii)* outside the school. We broke all the "rushes" off and made the heads smooth and round, using them as perches to sit on. We broke up for a fortnight's vacation and during that time the "rushes" grew rapidly, in the case of my own "mount" by about 5 inches. Blackboys eaten down by kangaroos or other animals grow a complete new head in a year. This may be seen in any virgin bush.

—W. H. BUTLER, East Perth.

Herons at Bunbury.—Adjacent to the beach at South Bunbury is a depressed area of about ten acres. During the winter rains this is converted into a miniature lake with a surrounding boggy swamp. It is favoured always by pairs or family parties of the local White-faced Heron *(Notophoyx novae-hollandiae)* and as the rains diminish and the pool contracts these birds are joined by pairs of the Pacific Heron *(N. pacifica)*. This year (1947) I noticed on frequent occasions a pair of the Nankeen Night Heron *(Nycticorax caledonicus)*. I took a field-glass with me and they proved to be the adults, with unspotted plumage. Last but certainly not least, was a distinguished visitor in a very fine individual of the large pure-white Egret *(Egretta alba)*.